US008437494B2

(12) **United States Patent**
Suzuki et al.

(10) **Patent No.: US 8,437,494 B2**
(45) **Date of Patent: May 7, 2013**

(54) **MOUNT STRUCTURE OF ELECTROMECHANICAL ACOUSTIC TRANSDUCER**

(75) Inventors: **Shinya Suzuki**, Shizuoka (JP); **Yukinari Inoue**, Shizuoka (JP)

(73) Assignee: **Panasonic Corporation**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 783 days.

(21) Appl. No.: **12/302,186**

(22) PCT Filed: **May 24, 2006**

(86) PCT No.: **PCT/JP2006/310349**

§ 371 (c)(1), (2), (4) Date: **Nov. 24, 2008**

(87) PCT Pub. No.: **WO2007/135740**

PCT Pub. Date: **Nov. 29, 2007**

(65) **Prior Publication Data**

US 2009/0232343 A1 Sep. 17, 2009

(51) **Int. Cl.**
H04R 1/02 (2006.01)

(52) **U.S. Cl.**
USPC **381/386**

(58) **Field of Classification Search** 381/386, 381/423, 351, 186, 396, 395; 181/166, 207
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,145,186 A * 11/2000 Beavers 29/594
7,113,813 B2 9/2006 Shimokawatoko et al.
2003/0003879 A1* 1/2003 Saiki et al. 455/90
2003/0059079 A1* 3/2003 Asahina et al. 381/396
2003/0076969 A1 4/2003 Han et al.
2004/0043801 A1 3/2004 Shimokawatoko et al.
2004/0071309 A1* 4/2004 Furuya et al. 381/424

FOREIGN PATENT DOCUMENTS

CN 1465205 A 12/2003
EP 1 538 871 A2 6/2005
EP 1 599 065 A1 11/2005
JP 2001-127858 A 5/2001
JP 2002-171596 A 6/2002
WO 03-007651 A1 1/2003
WO 2005/046067 A1 5/2005

OTHER PUBLICATIONS

International Search Report for PCT/JP2006/310349; Jun. 12, 2006.

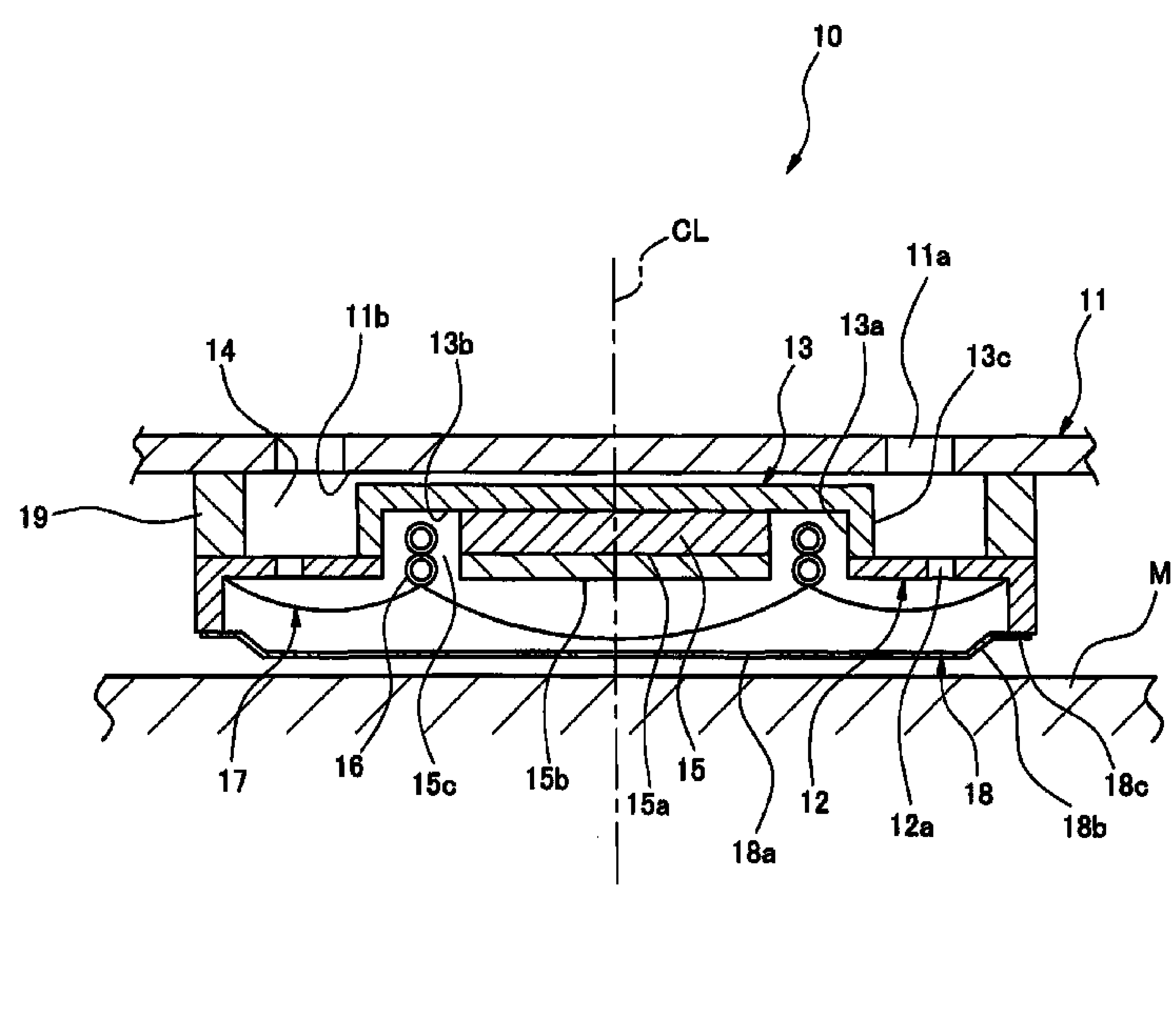
(Continued)

Primary Examiner — Zandra Smith
Assistant Examiner — Lawrence Tynes, Jr.
(74) *Attorney, Agent, or Firm* — Seed IP Law Group PLLC

(57) **ABSTRACT**

To provide a mount structure of an electromechanical acoustic transducer which enables making of an attempt to pursuit miniaturization while maintaining an acoustic characteristic. A cylindrical closed-end yoke **13** is attached to a frame **12**, which is attached to an interior surface **11***b* of a housing **11** by way of a wall portion **19**, in a direction where a bottom **13***b* of the yoke approaches the housing **11**; hence, a sound channel **14** is defined between the yoke **13** and the wall portion **19** without an increase in the thickness of the electromechanical acoustic transducer. A superior acoustic characteristic can hereby be acquired. Alternatively, the sound channel **14** can be assured even when the electromechanical acoustic transducer is miniaturized, and thus an attempt can be made to pursuit miniaturization while maintaining an acoustic characteristic.

10 Claims, 10 Drawing Sheets



OTHER PUBLICATIONS

Extended European Search Report, dated Jun. 19, 2012, for corresponding European Application No. 06756555.6, 6 pages.

Second Office Action, for corresponding Chinese Application No. 2006800546921, issued Dec. 12, 2011, 10 pages (with English Translation).

* cited by examiner

FIG.1

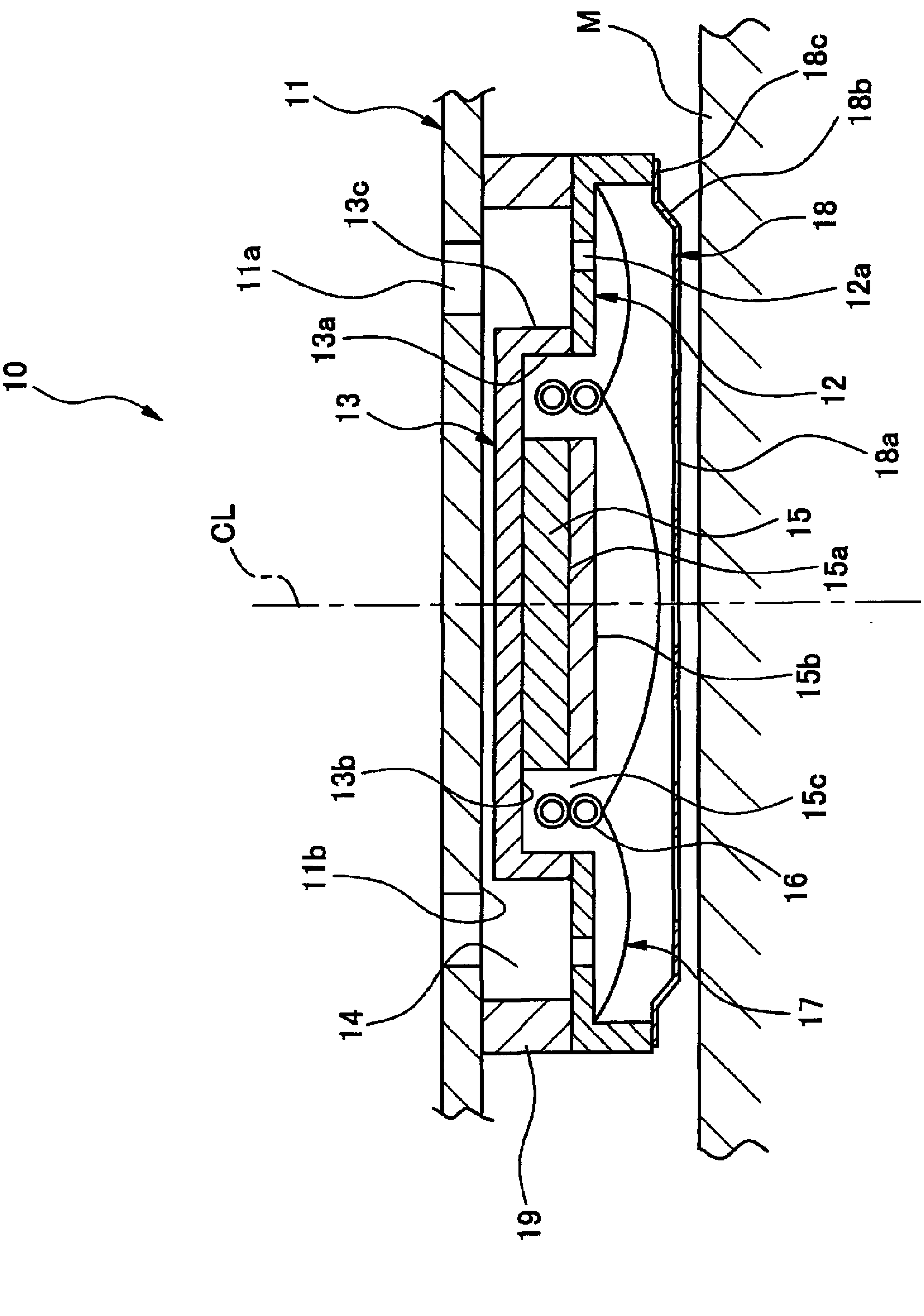
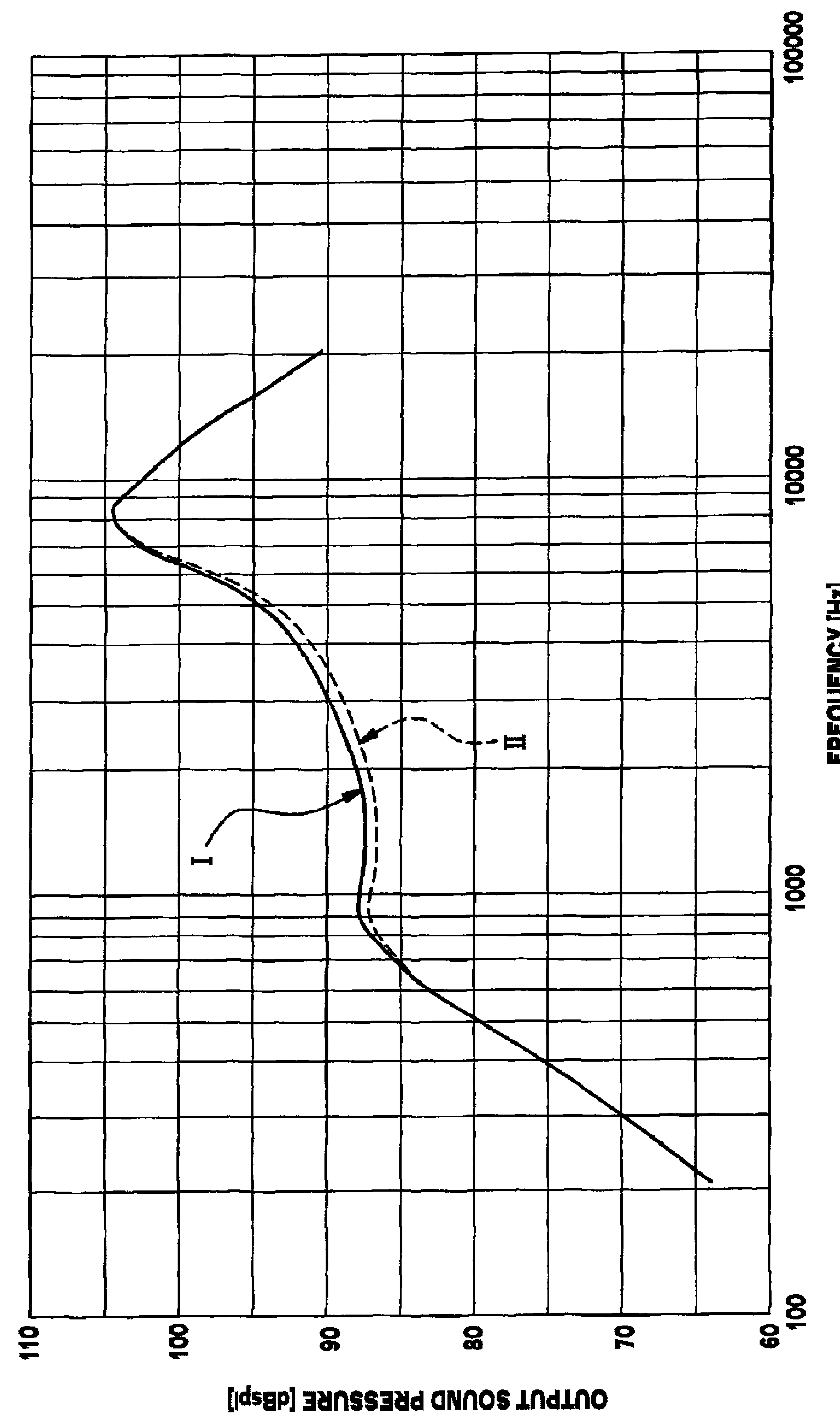
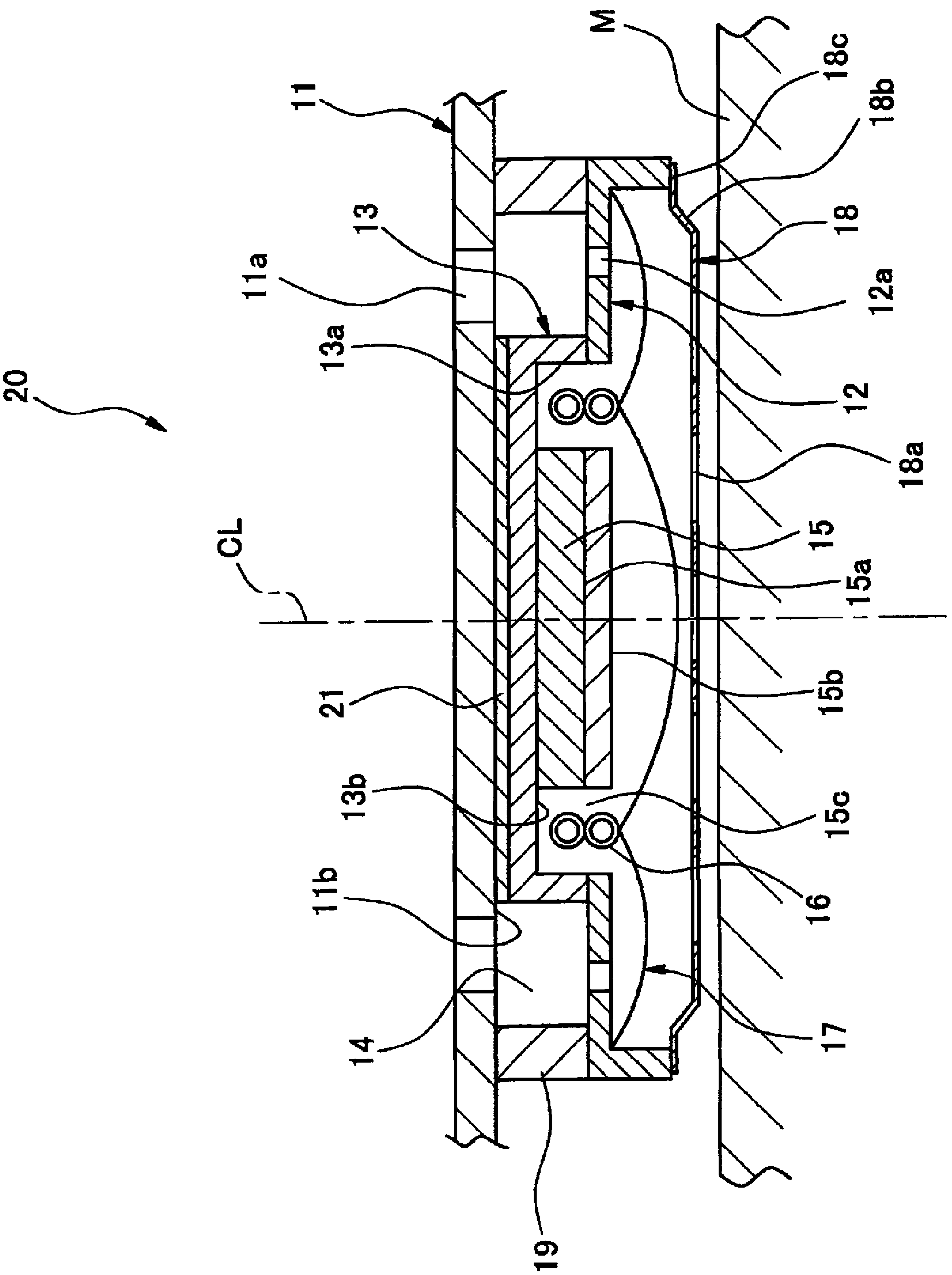

10
11
11a
11b
12
12a
13
13a
13b
13c
14
15
15a
15b
15c
16
17
18
18a
18b
18c
19
CL
M

FIG.2



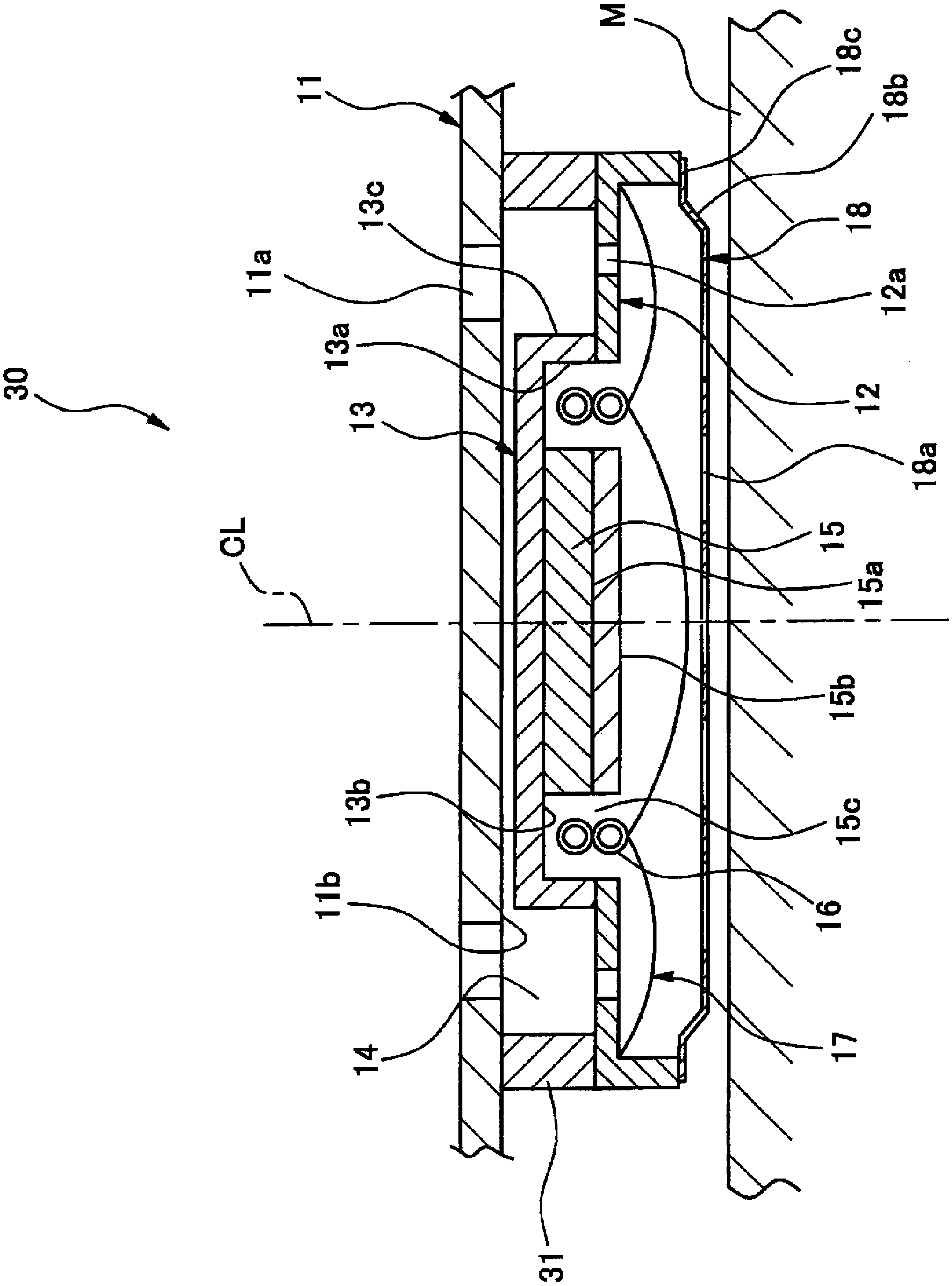
OUTPUT SOUND PRESSURE [dBspl]
110
100
90
80
70
60
FREQUENCY [Hz]
100
1000
10000
100000
I
II

FIG.3



20
11
11a
13
13a
CL
21
13b
11b
14
19
M
18c
18b
18
12a
12
18a
15
15a
15b
15c
16
17

FIG. 4


30
11
11a
13c
13a
13
CL
13b
11b
14
31
M
18c
18b
18
12a
12
18a
15
15a
15b
15c
16
17

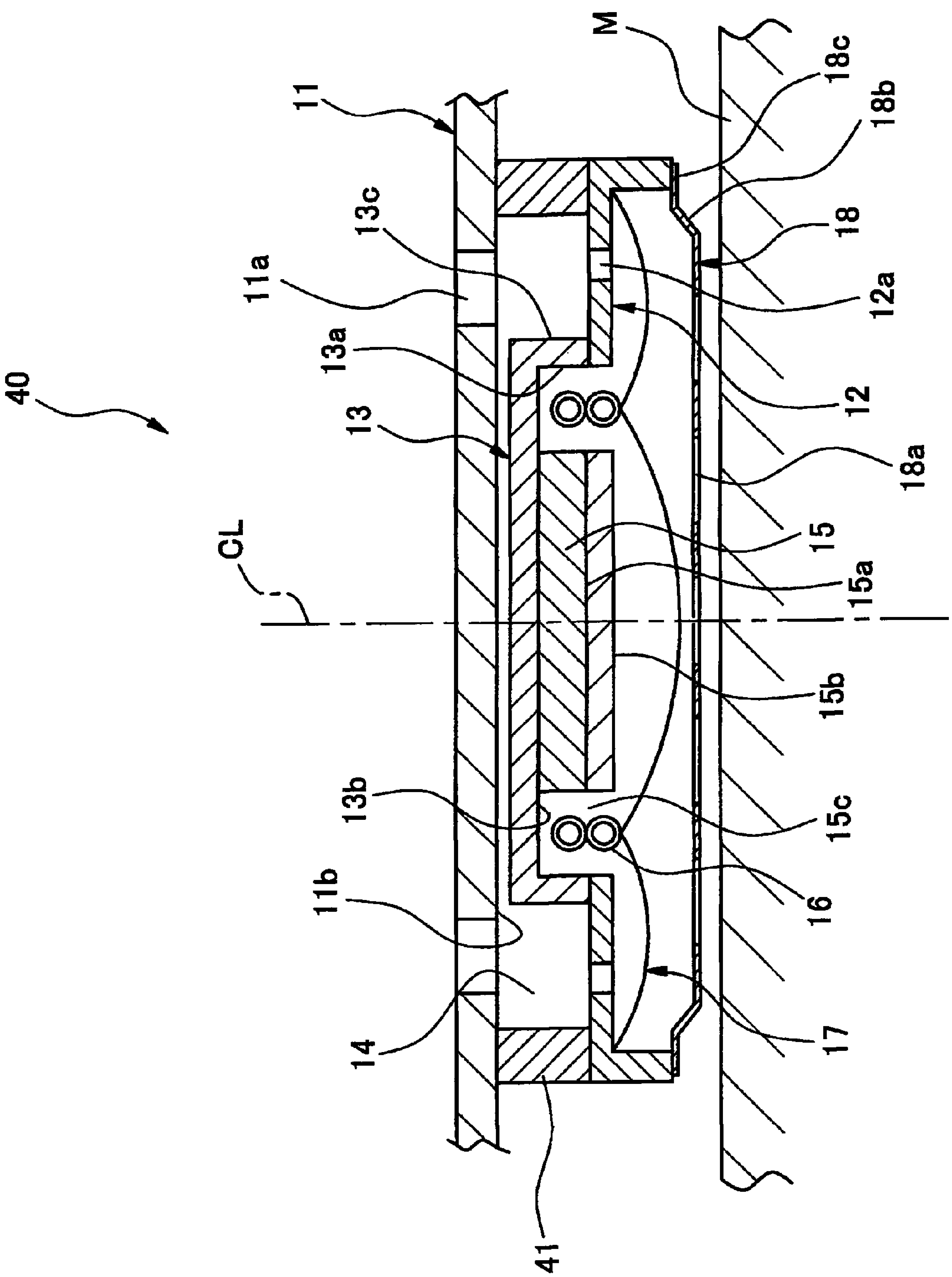
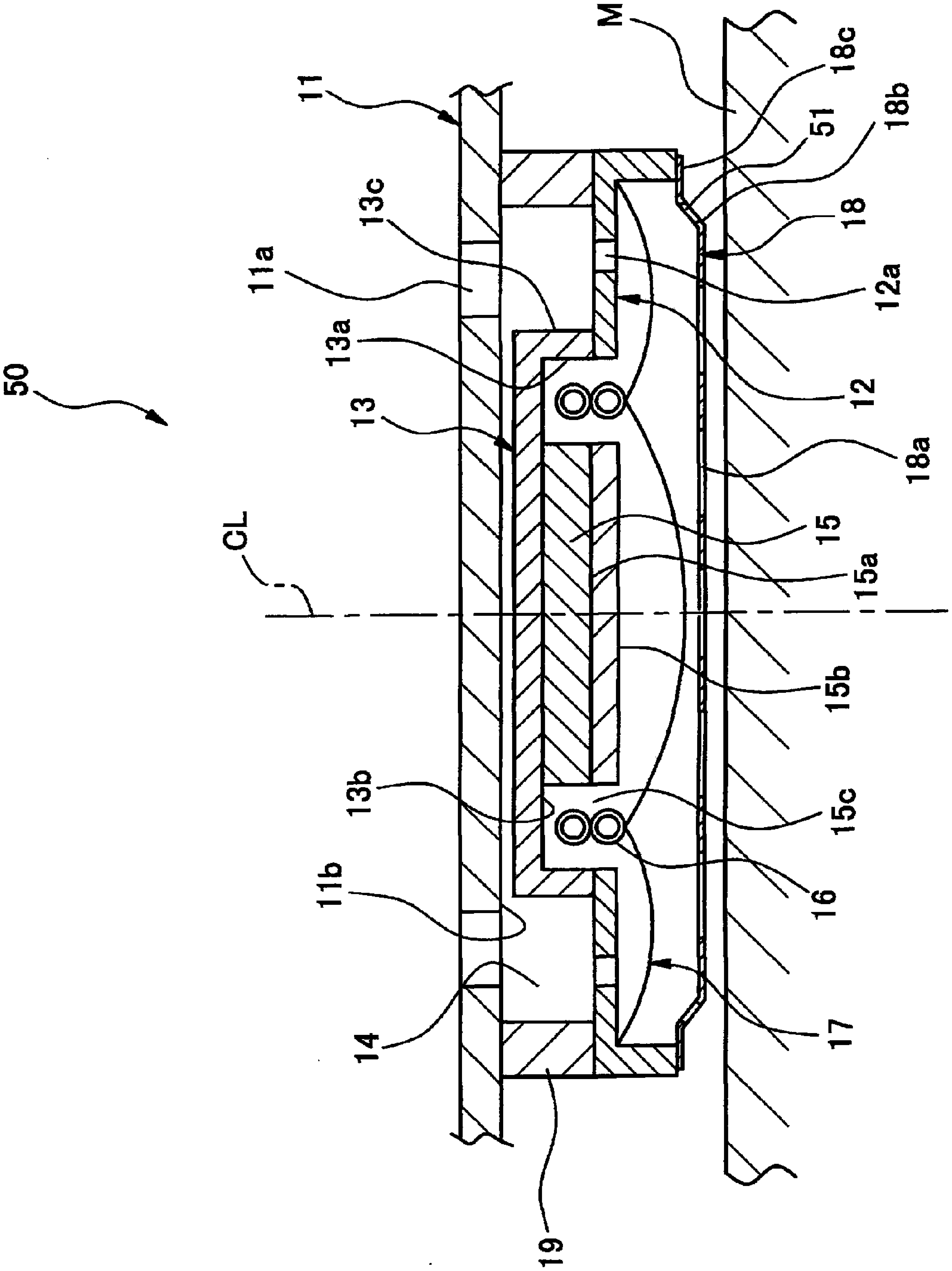

40
11
11a
13c
13a
13
CL
13b
11b
14
41
M
18c
18b
18
12a
12
18a
15
15a
15b
15c
16
17

FIG.5

FIG.6


50
11
11a
13c
13a
13
CL
13b
11b
14
19
M
18c
51
18b
18
12a
12
18a
15
15a
15b
15c
16
17

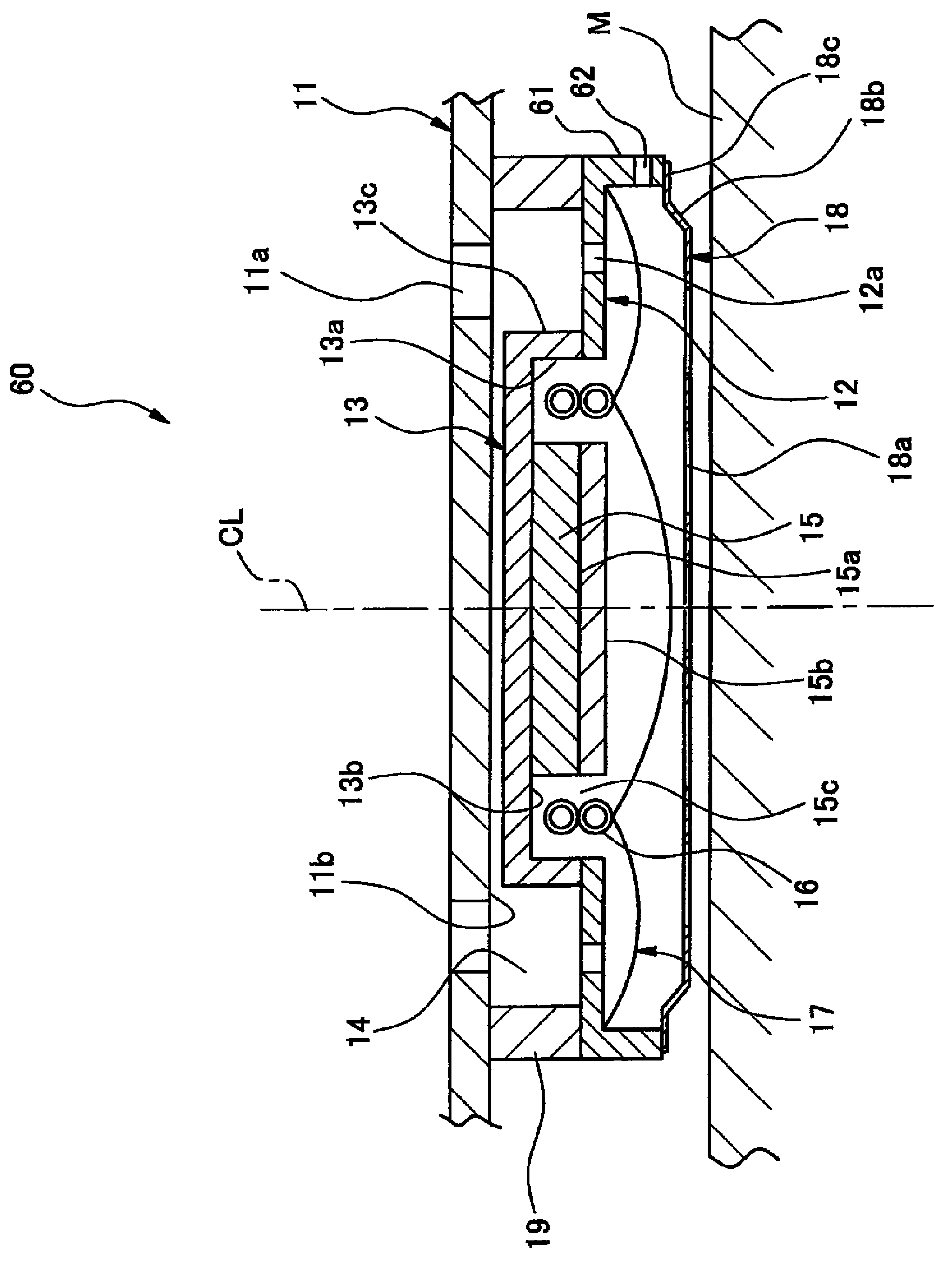
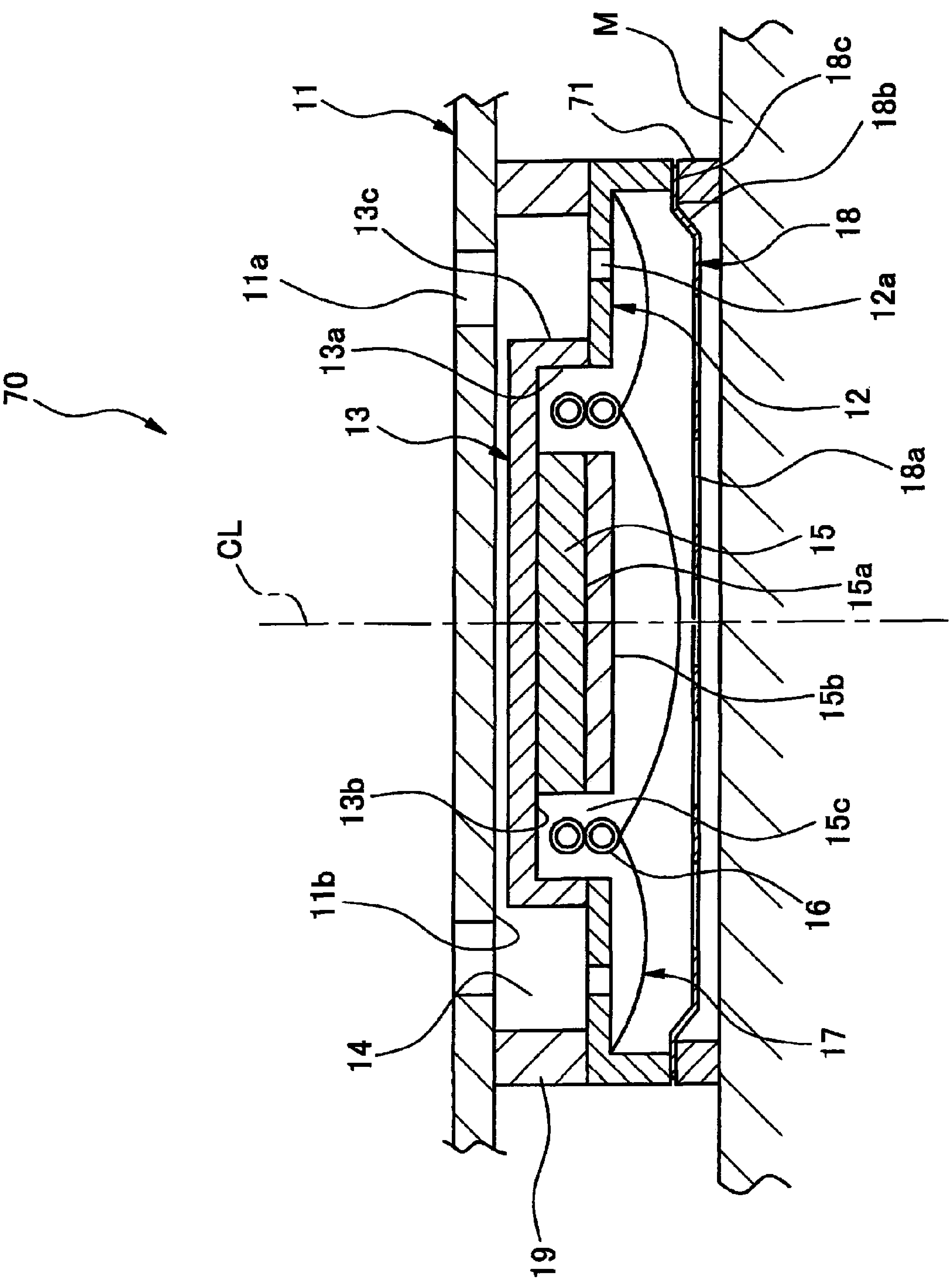

60
11
11a
13c
13a
13
CL
13b
11b
14
19
61
62
M
18c
18b
18
12a
12
18a
15
15a
15b
15c
16
17

FIG.7

FIG.8


70
CL
11
11a
11b
12
12a
13
13a
13b
13c
14
15
15a
15b
15c
16
17
18
18a
18b
18c
19
71
M

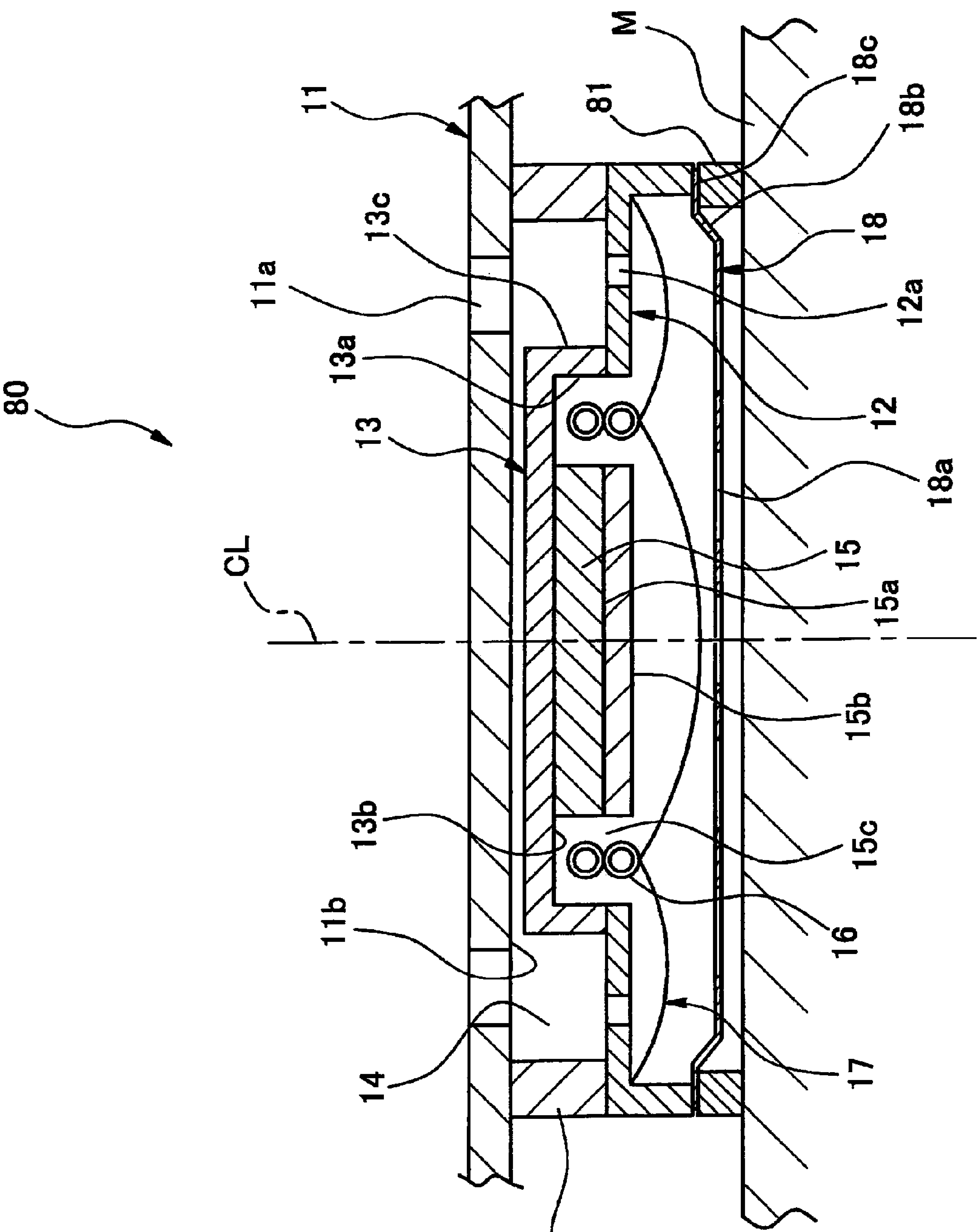
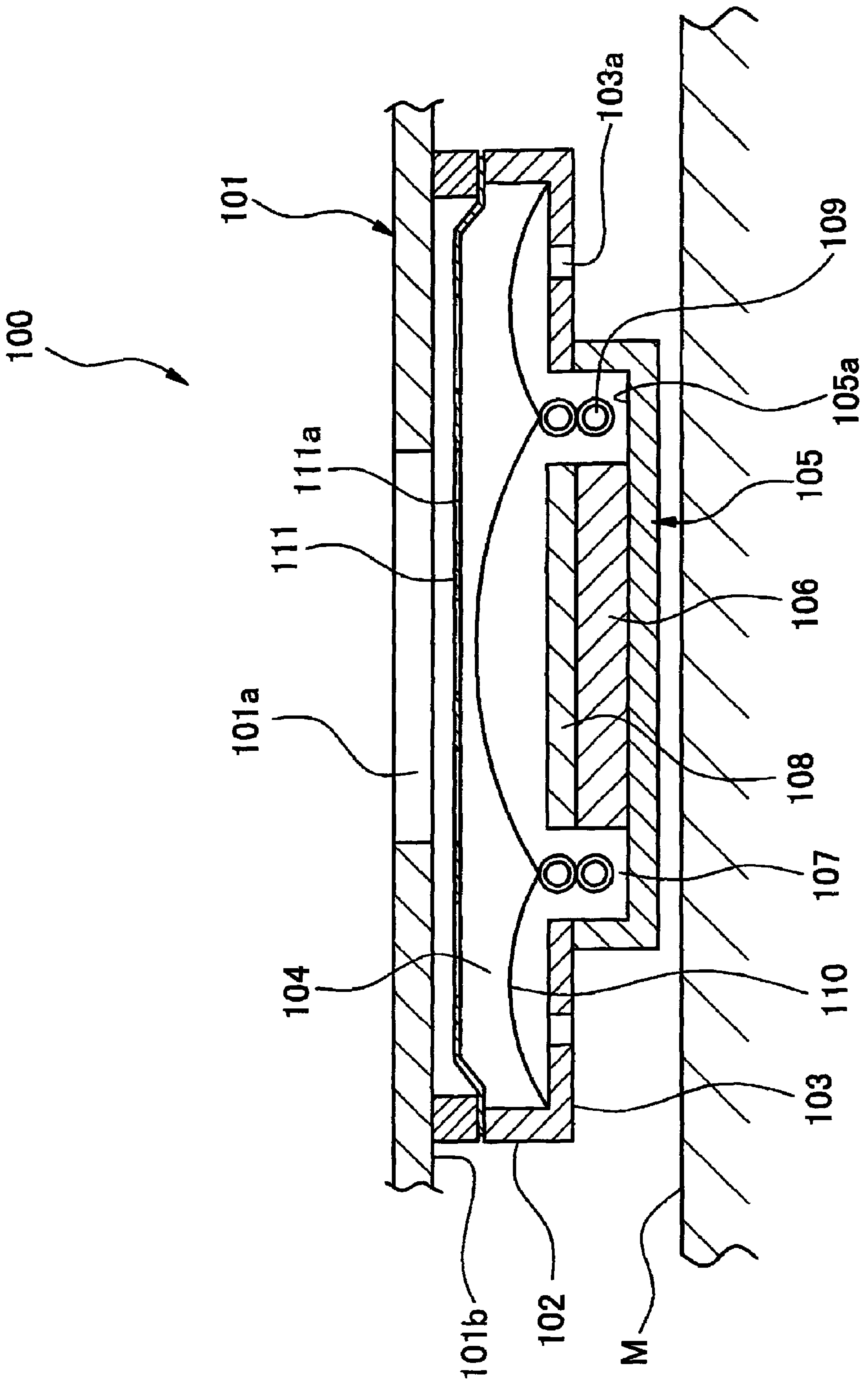

80
11
11a
11b
13c
13a
13
13b
CL
14
19
81
M
18c
18b
18
12a
12
18a
15
15a
15b
15c
16
17

FIG.9

FIG.10


100
101
101a
101b
102
103
103a
104
105
105a
106
107
108
109
110
111
111a
M

MOUNT STRUCTURE OF ELECTROMECHANICAL ACOUSTIC TRANSDUCER

TECHNICAL FIELD

The present invention relates to a mount structure of an electromechanical acoustic transducer, such as a speaker and a microphone, which is accommodated in a housing having a sound port.

BACKGROUND ART

As shown in FIG. **10**, a speaker **100** that is a related-art common electromechanical acoustic transducer has a housing **101** having a sound port **101***a* at the center portion of the housing **101**, and an essentially-plate-shaped frame **103** is attached to an interior surface **101***b* of the housing **101** through an rising portion **102** so as to generate an internal space **104**.

A cylindrical closed-end yoke **105** supported in correspondence with the internal space **104** is attached to the center portion of the frame **103**. A magnet **106** is attached to the inside of a bottom **105***a* of the yoke **105**, and a magnetic gap **107** is formed between an interior surface of the yoke **105** and the magnet **106**.

A plate **108** is attached to an apical surface of the magnet **106**. A voice coil **109** is inserted in the magnetic gap **107**. One end of the voice coil is attached to the bottom **105***a* of the yoke **105**, and the other end of the voice coil **109** is attached to the center portion of a diaphragm **110**.

A protector **111** for protecting the diaphragm **110** is provided in front of the diaphragm **110**, and first air holes **111***a* are provided in the protector **111**, and second air holes **103***a* are provided in the frame **103**.

In such a speaker **100**, the bottom **105***a* of the yoke **105** is arranged so as to face from the interior surface **101***b* of the housing **101** toward a departing direction (a downward direction in FIG. **10**). Since the yoke **105** is smaller in diameter than the frame **103**, a space exists between the frame **103** and another electronic component M housed in the housing **101**.

In order to achieve a superior acoustic characteristic, a necessity for assuring a sufficient space around the second air holes **103***a* for producing superior resonances of sound emitted from the second air holes **103***a* to the internal space **104** of the housing **101** has commonly been known (see; for instance, Patent Document 1).

Patent Document 1: JP-A-2002-171596

DISCLOSURE OF THE INVENTION

Problem that the Invention is to Solve

Incidentally, miniaturization of a recent portable terminal device, which is equipped with a speaker **100** as an electromechanical acoustic transducer, has been sought. However, assuring a sufficient space around the second air holes **103***a* causes the inconvenience of hindering miniaturization of the housing **101**.

The present invention has been conceived to solve the related-art problem and aims at providing a mount structure of an electromechanical acoustic transducer that enables making of an attempt to pursuit miniaturization while maintaining an acoustic characteristic.

Means for Solving the Problem

A mount structure of an electromechanical acoustic transducer of the present invention is a mount structure of an

electromechanical acoustic transducer housed in a housing having a sound port, comprising: an essentially-hollow-plate-shaped frame attached to an interior surface of the housing; a cylindrical closed-end yoke supported in correspondence to a hollow portion of the frame; a magnet provided at a bottom of the yoke so as to form a magnetic gap between an inner side surface of the yoke and the magnet; a plate provided at an end face of the magnet; a voice coil inserted into the magnetic gap; a diaphragm that is connected to the voice coil and that is supported by the frame; a protector provided on the frame for protecting the diaphragm; a first air hole provided in the protector; and a second air hole provided in the frame, wherein the bottom of the yoke is arranged so as to be oriented in a direction where the bottom approaches an interior surface of the housing, and a wall portion is interposed between the frame and the housing.

By the configuration, the cylindrical closed-end yoke is attached to the frame, which is attached to the interior surface of the housing by way of the wall portion, in a direction in which the bottom of the yoke approaches the housing. Hence, the sound channel is defined between the yoke and the wall portion without an increase in the thickness of the electromechanical acoustic transducer.

Thus, a superior acoustic characteristic can be acquired. Alternatively, even when the electromechanical acoustic transducer is miniaturized, the sound channel can be assured; hence, there is yielded an advantage of the ability to attempt to pursuit miniaturization while maintaining an acoustic characteristic.

The mount structure of an electromechanical acoustic transducer of the present invention has a configuration in which an interposition member having adhesiveness is sandwiched between the housing and the bottom of the yoke.

Moreover, the mount structure of an electromechanical acoustic transducer of the present invention has a configuration in which the wall portion has elasticity.

Further, the mount structure of an electromechanical acoustic transducer of the present invention has a configuration in which the wall portion has a damping characteristic.

The mount structure of an electromechanical acoustic transducer of the present invention further comprises a protector cutout portion formed in the protector, as well as having a configuration in which the protector cutout portion is provided so as to establish mutual communication between front and back of the protector in a direction crossing a direction of movement of the voice coil.

Further, the mount structure of an electromechanical acoustic transducer of the present invention has a configuration in which the frame has an rising portion which stands in a thickness direction and a frame cutout portion formed in the rising portion; and in which the frame cutout portion is provided so as to establish mutual communication between inside and outside of the rising portion along a direction crossing the direction of movement of the voice coil.

The mount structure of an electromechanical acoustic transducer of the present invention further comprises a support member interposed between the frame and an electronic component housed in the housing, as well as having a configuration in which the support member has elasticity.

The mount structure of an electromechanical acoustic transducer of the present invention further comprises a support member interposed between the frame and an electronic component housed in the housing, as well as having a configuration in which the support member has a damping characteristic.

Advantage of the Invention

By the configuration, the cylindrical closed-end yoke is attached to the frame, which is attached to the interior surface of the housing by way of the wall portion, in a direction in which the bottom of the yoke approaches the housing. Hence, the sound channel is defined between the yoke and the wall portion without an increase in the thickness of the electromechanical acoustic transducer, so that a superior acoustic characteristic can be acquired. Alternatively, even when the electromechanical acoustic transducer is miniaturized, the sound channel can be assured; hence, there can be provided a mount structure of an electromechanical acoustic transducer that yields an advantage of the ability to attempt to pursuit miniaturization while maintaining an acoustic characteristic.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a structural view showing a mount structure of an electromechanical acoustic transducer of a first embodiment of the present invention.

FIG. **2** is a graph showing a sound pressure frequency characteristic of the first embodiment of the present invention.

FIG. **3** is a structural view showing a mount structure of an electromechanical acoustic transducer of a second embodiment of the present invention.

FIG. **4** is a structural view showing a mount structure of an electromechanical acoustic transducer of a third embodiment of the present invention.

FIG. **5** is a structural view showing a mount structure of an electromechanical acoustic transducer of a fourth embodiment of the present invention.

FIG. **6** is a structural view showing a mount structure of an electromechanical acoustic transducer of a fifth embodiment of the present invention.

FIG. **7** is a structural view showing a mount structure of an electromechanical acoustic transducer of a sixth embodiment of the present invention.

FIG. **8** is a structural view showing a mount structure of an electromechanical acoustic transducer of a seventh second embodiment of the present invention.

FIG. **9** is a structural view showing a mount structure of an electromechanical acoustic transducer of an eighth embodiment of the present invention.

FIG. **10** is a structural view showing a mount structure of an electromechanical acoustic transducer of a related-art configuration.

DESCRIPTIONS OF THE REFERENCE NUMERALS

10 mount structure of electromechanical acoustic transducer
11 housing
11*a* sound port
12 frame
12*a* second air hole
13 yoke
13*a* interior surface
13*b* bottom
15 magnet
15*a* end face
15*b* plate
15*c* magnetic gap
16 voice coil
17 diaphragm
18 protector
18*a* first air hole
19 wall portion
21 interposition member
51 protector cutout portion
61 rising portion
62 frame cutout portion
71 support member
81 support member
M electronic component

BEST MODES FOR IMPLEMENTING THE INVENTION

Mount structures for an electromechanical acoustic transducer of embodiments of the present invention will be described hereunder by reference to the drawings.

First Embodiment

FIG. **1** shows a mount structure of an electromechanical acoustic transducer of a first embodiment of the present invention.

In FIG. **1**, a mount structure **10** of an electromechanical acoustic transducer, such as a speaker and a microphone, of a first embodiment has an essentially-hollow-plate-shaped frame **12** attached to an interior surface **11***b* of a housing **11** having sound ports **11***a*; an end-closed cylindrical yoke **13** supported in correspondence to a hollow of the frame **12**; a magnet **15** provided on a bottom **13***b* of the yoke **13** so as to generate a magnetic gap **15***c* between the magnet and an interior surface **13***a* of the yoke **13**; a plate **15***b* provided at an end face **15***a* of the magnet **15**; a voice coil **16** inserted into the magnetic gap **15***c*; a diaphragm **17** that is connected to the voice coil **16** and that is supported by the frame **12**; and a protector **18** provided on the frame **12** for protecting the diaphragm **17**.

First air holes **18***a* are provided in the protector **18**, and second air holes **12***a* are provided in the frame **12**.

The bottom **13***b* of the yoke **13** is arranged so as to be oriented toward an approaching direction with respect to the interior surface **11***b* of the housing **11** (an upward direction in FIG. **1**), and a wall portion **19** is interposed between the frame **12** and the housing **11**.

Sound ports **11***a* cut into; for instance, a plurality of circular-arc segments of a circle that is around a center portion line CL are provided in the housing **11**. The wall portion **19** is concentrically provided outside the sound ports **11***a*, and the frame **12** is attached to an interior end face of the wall portion **19**.

The second air holes **12***a* provided in the frame **12** are provided opposite the sound ports **11***a* of the housing **11** at the inside of the wall portion **19** in the form of circular-arc segments of a circle.

The center portion of the frame **12** is cut into a circular shape, and the end-closed cylindrical yoke **13** is provided so as to protrude toward the housing **11**.

Accordingly, a sound channel **14** surrounded by the housing **11**, the wall portion **19**, the frame **12**, and a longitudinal wall portion **13***c* of the yoke **13** is defined. The sound ports **11***a* are provided at the front of the sound channel **14**, and the second air holes **12***a* are provided on the rear of the same.

The second air holes **12***a* provided in the frame **12** are intended for letting air between the frame **12** and the diaphragm **17** escape and guides the sound generated by the diaphragm **17** to the sound ports **11***a* by way of the sound channel **14**.

In the meantime, the first air holes **18***a* are provided in the protector **18**, and the protector **18** is attached to a lower surface of the frame **12** through a rising portion **18***b* and a fringe **18***c*. The first air holes **18***a* are intended for letting air between the diaphragm **17** and the protector **18** escape. For instance, a plurality of circular through holes, or the like, are provided in an entirety of the protector **18**.

A joint of the frame **12** facing the sound channel **14** must be airtight so as not to cause phase interference between sound emitted from the second air holes **12***a* and the sound emitted from the first air holes **18***a*. For this reason, it is desirable to assure airtight-ness for the joint between the frame **12** and the wall portion **19** by combination of mutually projecting shapes or by use of an adhesive double-sided tape.

In order to generate superior resonances of the sound emitted from the first air holes **18***a* in an internal space of the housing **11**, it is desirable to make cutout portions, for which a sufficiently large area is assured, in the first air holes **18**.

The protector **18** is not limited to a specific material or shape. However, it is desirable to form the protector **18** from; for instance, metal and assure a thickness that prevents anomalous sound, which would otherwise be caused by emission of sound from the electromechanical acoustic transducer.

In relation to the gap existing between the protector **18** and the component M in the housing **11**, it is desirable to assure the minimum gap that prevents anomalous sound, which would otherwise be caused when the protector **18** is vibrated and contact the component M as a result of emission of sound from the electromechanical acoustic transducer.

Operation of the mount structure **10** of the electromechanical acoustic transducer will now be described by reference to FIG. **1**.

For instance, an electro-dynamic speaker can be exemplified as the electromechanical acoustic transducer. When an electric signal is applied to the voice coil **16** inserted in the magnetic gap **15***c* of the electro-dynamic speaker, drive force develops in the voice coil **16**, thereby vibrating the diaphragm **17** connected to the voice coil **16**, to thus cause a pressure change in air in the frame **12**. The pressure change generates sound to a space outside of the housing **11** by way of the sound channel **14** and the sound ports **11***a* via the second air holes **12***a*.

In the meantime, the sound generated by the first air holes **18***a* generates resonances in the housing **11**. At this time, the larger becomes the volume of a space around the first air holes **18***a*, the superior an acoustic characteristic is acquired.

Next, an acoustic characteristic of the mount structure **10** of the electromechanical acoustic transducer of the present invention will be described by use of a test result by reference to FIG. **2**.

FIG. **2** is a correlation diagram showing a sound pressure frequency characteristic of the speaker **100** serving as a related-art electromechanical acoustic transducer shown in FIG. **10** and a sound pressure frequency characteristic of the mount structure **10** of the foregoing electromechanical acoustic transducer of the present invention shown in FIG. **1**. Specific numerical values provided below are set only for quantitatively grasping advantages of the present invention. Numerical values are illustrative, and the individual numerical values do not pose any restriction on the true nature of the present invention.

In analysis of the test shown in FIG. **2**, each of the related-art speaker **100** and the mount structure **10** of the electromechanical acoustic transducer of the present invention uses an electro-dynamic speaker having a diameter ϕ of 14 mm and a thickness "t" of 2.9 mm. The housings **11** and **101** assume the same shape. A distance between the housing **11** and the component M in the housing and a distance between the housing **101** and the component positioned therein assume an identical value of 3.5 mm.

In the related-art speaker **100**, a gap between the housing **101** and the protector **111** is set to 0.5 mm, and a gap between the yoke **105** and the component M in the housing is set to 0.1 mm.

In the mount structure **10** of the electromechanical acoustic transducer of the present invention, the gap between the housing **11** and the yoke **13** is set to 0.1 mm, and a gap between the protector **18** and the component M in the housing is set to 0.5 mm.

A test was analyzed by placing microphones of the same model at a position that is separated from the sound ports **11***a* by 0.1 m and by means of settings of application of 0.2 W to the related-art speaker **100** and the mount structure **10** of the electromechanical acoustic transducer of the present invention.

A characteristic I designated by a broken line in FIG. **2** represents a result of measurement of the related-art speaker **100**. A characteristic II is designated by a solid line and represents a result of measurement of the mount structure **10** of the electromechanical acoustic transducer of the present invention.

As shown in FIG. **2**, when compared with that of the characteristic I with a range from about 1000 Hz to 5000 Hz, a sound pressure level of the characteristic II is enhanced by about 1 dB. This generally means that the air becomes more difficult to escape from the respective air holes **18***a*, **12***b*, **111***a*, and **103***a* as the gap between the electromechanical acoustic transducer and the component M in the housing becomes narrower, to thus incur deterioration of sound pressure.

However, in the mount structure **10** of the electromechanical acoustic transducer of the present invention, the first air holes **18***a* are larger than the second air holes **12***b* by about two to five times in terms of an aperture area. Hence, escape of air from the first air holes **18***a* in the mount structure **10** of the electromechanical acoustic transducer of the present invention becomes easier than escape of air from the related-art speaker **100**, which lessens deterioration of sound pressure.

Provided that deterioration of sound pressure identical with that caused by the related-art speaker **100** is allowed, the mount structure **10** of the electromechanical acoustic transducer of the present invention enables a reduction in the gap between the protector **18** and the component M in the housing **11** and a further reduction in the thickness of the speaker.

Since the electro-dynamic speaker employs the magnets **15**, **106** as constituent components, there arises leakage flux to the outside of the housing **11** and **101**.

In the related-art speaker **100**, a component opposing the housing **101** is the protector **111**. In the mount structure **10** of the electromechanical acoustic transducer of the present invention, a component opposing the housing **11** is the yoke **13**. Respective components are not limited to specific materials or shapes. However, when the components are formed from; for instance, single metal, the yoke **13** is about two to four times as thick as the protector **111**, and hence leakage flux to the outside of the housing **11** is reduced by about 30%.

This is significant in connection with reliability of a non-contact IC card of magnetic storage type.

In the mount structure **10** of the electromechanical acoustic transducer of the present invention, the second air holes **12***a* are made smaller than the first air holes **18***a* by about one-half to one-fifth in terms of an aperture area. When a keen object is inserted from the sound ports **11***a*, the potential of the second air holes **12***a* protecting the diaphragm **17** is enhanced, as well.

This is significant in connection with reliability achieved when equipment is put in a bag, or the like,

According to the mount structure **10** of the foregoing electromechanical acoustic transducer, the cylindrical closed-end yoke **13** is attached, in a direction in which the bottom **13***b* approaches the housing **11**, to the frame **12** attached to the interior surface **11***b* of the housing **11** by way of the wall portion **19**. Hence, the sound channel **14** having a sufficient space is defined between the yoke **13** and the wall portion **19** without an increase in the thickness of the electromechanical acoustic transducer.

A superior acoustic characteristic can be acquired thereby. Alternatively, the sound channel **14** can be assured even when the electromechanical acoustic transducer is miniaturized, and hence an attempt can be made to pursuit miniaturization while maintaining an acoustic characteristic.

Second Embodiment

A mount structure of an electromechanical acoustic transducer of a second embodiment of the present invention will now be described.

A mount structure **20** of an electromechanical acoustic transducer of the second embodiment is shown in FIG. **3**. Areas common to those of the mount structure **10** of the electromechanical acoustic transducer of the aforementioned first embodiment are assigned the same reference numerals, and their repeated explanations are omitted.

In the mount structure **20** of the electromechanical acoustic transducer, an interposition member **21** having an adhesiveness is sandwiched between the housing **11** and the bottom **13***b* of the yoke **13**.

In the adhesive material **21**, it is desirable to assure stable adhesiveness by use of; for instance, an adhesive double-sided tape.

Operation of the mount structure **20** of the electromechanical acoustic transducer is the same as that of the mount structure **10** of the electromechanical acoustic transducer described in connection with the foregoing first embodiment.

The mount structure **20** of the electromechanical acoustic transducer of the foregoing second embodiment of the present invention enables enhancement of magnetic-proof and dust-proof characteristics as well as assurance of acoustic performance as in the first embodiment. Further, the mount structure enables fastening of the yoke **13** to the housing **11** by provision of the adhesive interposition member **21** between the housing **11** and the bottom **13***b* of the yoke **13**.

Third Embodiment

A mount structure of an electromechanical acoustic transducer of a third embodiment of the present invention will now be described.

A mount structure **30** of an electromechanical acoustic transducer of the third embodiment is shown in FIG. **4**. Areas common to those of the mount structure **10** or **20** of the electromechanical acoustic transducer of the aforementioned first or second embodiment are assigned the same reference numerals, and their repeated explanations are omitted.

In the mount structure **30** of the electromechanical acoustic transducer, a wall portion **31** is formed from a member exhibiting elasticity.

Specifically, one side surface of the sound channel **14** is built from an elastic member. The elastic element is not limited to a specific material or shape. However, it is desirable to form the elastic element from; for instance, foam urethane rubber, or the like, and to ensure airtight-ness by holding the elastic element between the frame **12** and the housing **11** of the electromechanical acoustic transducer.

It is desirable for the frame **12** and the housing **11**, which contact the wall portion **31** corresponding to an elastic element, to assure airtight-ness by use of an adhesive double-sided tape.

Operation of the mount structure **30** of the electromechanical acoustic transducer is the same as that of the mount structure **10** of the electromechanical acoustic transducer described in connection with the foregoing first embodiment.

The mount structure **30** of the electromechanical acoustic transducer of the foregoing third embodiment of the present invention enables enhancement of magnetic-proof and dust-proof characteristics as well as assurance of acoustic performance as in the first embodiment. Further, since the wall portion **31** has elasticity, vibration-proof can be enhanced.

Fourth Embodiment

A mount structure of an electromechanical acoustic transducer of a fourth embodiment of the present invention will now be described.

A mount structure **40** of an electromechanical acoustic transducer of the fourth embodiment is shown in FIG. **5**.

Areas common to those of the mount structure **10**, **20**, or **30** of the electromechanical acoustic transducer of the aforementioned first, second, or third embodiment are assigned the same reference numerals, and their repeated explanations are omitted.

In the mount structure **40** of the electromechanical acoustic transducer, a wall portion **41** is formed from a member exhibiting a damping characteristic. The wall portion **41** having a damping characteristic is not limited to any specific material or shape. It is desirable to form the wall portion from; for instance, a silicon-based gel material, or the like, and hold the wall portion between the frame **12** and the housing **11**, to thus assure airtight-ness. It is desirable for the frame **12** and the housing **11**, which contact the wall portion **41**, to assure airtight-ness by mutually projecting shapes.

Operation of the mount structure **40** of the electromechanical acoustic transducer is the same as that of the mount structure **10** of the electromechanical acoustic transducer described in connection with the foregoing first embodiment.

The mount structure **40** of the electromechanical acoustic transducer of the foregoing fourth embodiment of the present invention enables enhancement of magnetic-proof and dust-proof characteristics as well as assurance of acoustic performance as in the first embodiment. Further, since the wall portion **41** has a damping characteristic, vibration-proof can be enhanced.

Fifth Embodiment

A mount structure of an electromechanical acoustic transducer of a fifth embodiment of the present invention will now be described.

A mount structure **50** of an electromechanical acoustic transducer of the fifth embodiment is shown in FIG. **6**. Areas common to those of the mount structures **10** . . . **40** of the electromechanical acoustic transducers of the aforementioned first through fourth embodiments are assigned the same reference numerals, and their repeated explanations are omitted.

In the mount structure **50** of the electromechanical acoustic transducer, a protector cutout portion **51** is provided in the protector **18**, and the protector cutout portion **51** is provided so as to establish mutual communication between the front and back of the protector **16** along a direction (the horizontal direction in FIG. **6**) crossing the direction of movement of the voice coil **16** (the vertical direction in FIG. **6**). The protector cutout portion **51** is not limited to any specific shape but penetrates through; for instance, a rising portion **18***b* of the protector **18**, in the horizontal direction in FIG. **6**, thereby further facilitating escape of air from the first air holes **18***a*.

Operation of the mount structure **50** of the electromechanical acoustic transducer is the same as that of the mount structure **10** of the electromechanical acoustic transducer described in connection with the foregoing first embodiment.

The mount structure **50** of the electromechanical acoustic transducer of the foregoing fifth embodiment of the present invention enables enhancement of magnetic-proof and dust-proof characteristics as well as assurance of acoustic performance as in the first embodiment. Further, as a result of the protector cutout portion **51** being provided in the protector **18**, escape of air is further facilitated, whereupon acoustic performance can be enhanced.

Sixth Embodiment

A mount structure of an electromechanical acoustic transducer of a sixth embodiment of the present invention will now be described.

A mount structure **60** of an electromechanical acoustic transducer of the sixth embodiment is shown in FIG. **7**. Areas common to those of the mount structures **10** . . . **50** of the electromechanical acoustic transducers of the aforementioned first through fifth embodiments are assigned the same reference numerals, and their repeated explanations are omitted.

In the mount structure **60** of the electromechanical acoustic transducer, the frame **12** has a rising portion **61** that stands in a thickness direction and a frame cutout portion **62** provided in the rising portion **61**. The frame cutout portion **62** is arranged so as to establish mutual communication between the outside and inside of the rising portion **61** along a direction (the horizontal direction in FIG. **7**) crossing the direction of movement of the voice coil **16**. The frame cutout portion **62** is not limited to any specific shape; however, it is desirable to provide the frame cutout portion so as to be oriented in the horizontal direction of the electromechanical acoustic transducer such that escape of air from the first air holes **18***a* is much facilitated.

Operation of the mount structure **60** of the electromechanical acoustic transducer is the same as that of the mount structure **10** of the electromechanical acoustic transducer described in connection with the foregoing first embodiment.

The mount structure **60** of the electromechanical acoustic transducer of the foregoing sixth embodiment of the present invention enables enhancement of magnetic-proof and dust-proof characteristics as well as assurance of acoustic performance as in the first embodiment. Further, as a result of the rising portion **61**, which stands in the thickness direction, being provided in the frame **12** and the frame cutout portion **62** being provided in the rising portion **61**, escape of air is further facilitated, whereupon acoustic performance can be enhanced.

Seventh Embodiment

A mount structure of an electromechanical acoustic transducer of a seventh embodiment of the present invention will now be described.

A mount structure **70** of an electromechanical acoustic transducer of the seventh embodiment is shown in FIG. **8**. Areas common to those of the mount structures **10** . . . **60** of the electromechanical acoustic transducers of the aforementioned first through sixth embodiments are assigned the same reference numerals, and their repeated explanations are omitted.

The mount structure **70** of the electromechanical acoustic transducer has a support member **71** interposed between the frame **12** and the electronic component M housed in the housing **11**, and the support member **71** has elasticity.

The support member **71** is not limited to any specific material or shape. However, it is desirable to form the support member from; for instance, foam urethane rubber, or the like, and build the support member from; for instance, a plurality of blocks, so as to prevent escape of air from the first air holes **18***a* or generate the support member into a shape having an opening, such as the shape of the letter C. Operation of the mount structure **70** of the electromechanical acoustic transducer is the same as that of the mount structure **10** of the electromechanical acoustic transducer described in connection with the foregoing first embodiment.

The mount structure **70** of the electromechanical acoustic transducer of the foregoing seventh embodiment of the present invention enables enhancement of magnetic-proof and dust-proof characteristics as well as assurance of acoustic performance as in the first embodiment. Further, as a result of the elastic support member **71** being interposed between the frame **12** and the electronic component M housed in the housing **11**, escape of air from the location is prevented, so that acoustic performance can be enhanced.

Eighth Embodiment

A mount structure of an electromechanical acoustic transducer of an eighth embodiment of the present invention will now be described.

A mount structure **80** of an electromechanical acoustic transducer of the eighth embodiment is shown in FIG. **9**.

Areas common to those of the mount structures **10** . . . **70** of the electromechanical acoustic transducer of the aforementioned first through seventh embodiments are assigned the same reference numerals, and their repeated explanations are omitted.

The mount structure **80** of the electromechanical acoustic transducer has a support member **81** interposed between the frame **12** and the electronic component M housed in the housing **11**, and the support member **81** exhibits a damping characteristic. The support member **81** is not limited to any specific material or shape. It is desirable to form the support member from; for instance, a silicon-based gel material, or the like, and build the support member from; for instance, a plurality of blocks, so as to prevent escape of air from the first air holes **18***a* or generate the support member into a shape having an opening, such as the shape of the letter C.

Operation of the mount structure **80** of the electromechanical acoustic transducer is the same as that of the mount structure **10** of the electromechanical acoustic transducer described in connection with the foregoing first embodiment.

The mount structure **80** of the electromechanical acoustic transducer of the foregoing eighth embodiment of the present invention enables enhancement of magnetic-proof and dust-proof characteristics as well as assurance of acoustic performance as in the first embodiment. Further, as a result of the support member **81** having a damping characteristic being interposed between the frame **12** and the electronic component M housed in the housing **11**, escape of air from the location is prevented, so that acoustic performance can be enhanced.

The electro-dynamic speaker is used as the electromechanical acoustic transducer in the foregoing descriptions. However, a similar advantage is yielded even when any electromechanical acoustic transducer is used, so long as the transducer has a shape, such as projection of the yoke **13** with respect to the frame **12**, as in an electro-dynamic receiver, and the like.

Although descriptions have been provided for the case where the outer shape of the electromechanical acoustic transducer is round, a similar advantage is yielded even when the transducer assumes another shape, such as an oval or rectangular shape.

INDUSTRIAL APPLICABILITY

As mentioned above, in the mount structures of the electromechanical acoustic transducers of the present embodiments, the cylindrical closed-end yoke is attached to the frame, which is attached to the interior surface of the housing by way of the wall portion, in a direction in which the bottom of the yoke approaches the housing. Hence, the sound channel is defined between the yoke and the wall portion without an increase in the thickness of the electromechanical acoustic transducer, so that a superior acoustic characteristic can be acquired.

Alternatively, even when the electromechanical acoustic transducer is miniaturized, the sound channel can be assured; hence, there is yielded an advantage of the ability to attempt to pursuit miniaturization while maintaining an acoustic characteristic. The mount structure is useful as a mount structure of an electromechanical acoustic transducer, such as a speaker and a microphone, housed in a housing having a sound port.

The invention claimed is:

1. A mount structure of an electromechanical acoustic transducer housed in a housing, comprising:
- a frame having a hollow portion, a first frame surface and a second frame surface opposite the first frame surface, and a hole linking the first frame surface of the frame and the second frame surface of the frame;
- a wall connected to the first frame surface and to an inner surface of the housing, thereby supporting the frame;
- a yoke supported by the first frame surface of the frame, the yoke protruding from the first frame surface toward the inner surface, thereby a housing space for housing a magnet and a voice coil is formed by the protruding yoke and the hollow portion, wherein a distance between at least a portion of the protruding yoke and the inner surface of the housing is less than a distance between a portion of the first frame surface supporting the yoke and the inner surface of the housing; and
- a diaphragm connected to the voice coil and supported by the second frame surface of the frame.

2. The mount structure according to claim **1**, further comprising:
- a protector covering the diaphragm and including a first protector surface facing the diaphragm and a second protector surface opposite the first protector surface, the protector covering further including a hole extending between the first protector surface to the second protector surface.

3. The mount structure according to claim **2**, wherein
- the protector has a rising portion connected to the second frame surface by a fringe portion of the protector, and a protector cutout portion disposed on the rising portion, the protector cutout portion extending between the first protector surface and the second protector surface.

4. The mount structure according to claim **1**, wherein an interposition member having adhesiveness is disposed between the inner surface of the housing and the protruding portion of the yoke.

5. The mount structure according to claim **1**, wherein the wall portion has elasticity.

6. The mount structure according to claim **1**, wherein the wall portion has damping characteristic.

7. The mount structure according to claim **1**, wherein
- the frame has a protruding portion supporting the protector, thereby the housing space includes a space formed by the protruding portion of the frame and the protector and houses the diaphragm, and
- the protruding portion of the frame has a frame cutout portion linking an outer area of the housing space and an inner area of the housing space.

8. The mount structure according to claim **1**, further comprising:
- a support member disposed between the frame and an electronic component housed in the housing, wherein the support member has elasticity.

9. The mount structure according to claim **1**, comprising:
- a support member disposed between the frame and an electronic component housed in the housing, wherein the support member has a damping characteristic.

10. A portable terminal device comprising an electromechanical acoustic transducer described in claim **1**.

* * * * *